Does institutional ownership improve firm investment efficiency?

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Abstract:

Our study examines the influence of institutional investors on firm investment efficiency based on the non-financial firms listed on Chinese stock exchanges over the period of 2009–2014. Our results show that institutional ownership generally improves firm investment efficiency. However, after considering the independence of institutional ownership, we find that only pressure-resistant institutional ownership increases firm investment efficiency by alleviating both over-investment and underinvestment. We also find that the pressure-resistant institution investors' horizon matters. In particular, the pressure-resistant institution investors that have higher shareholdings are more stable, i.e. they tend to hold shares for a longer term, and thus have more intensive effect on firm investment efficiency. Our results also show that relaxing external financing constraints, reducing agency costs and increasing executive incentives significantly improve firm investment efficiency. The results are robust to controlling for endogeneity. Documenting the positive influence that pressure-resistant institutional investors have on firm investment efficiency and the channels through which they improve firm investment efficiency should be of interest to investors, regulators and academics.

Key words: Institutional Ownership; Investment Efficiency; Corporate Governance; Channel; China

1 Introduction

Making optimal investment decisions is the most important responsibility of senior management and also a fundamental issue in corporate finance. A firm's investment decisions and their outcomes determine the firm's future cash flows and profitability, and have a profound effect on the firm's long-term survival and growth (Liu et al. 2015). In a world free of market imperfection, any projects with positive net present value should be carried out, until the marginal revenue equals the marginal cost of capital (Midigliani and Millar, 1958). However, due to various frictions in the real world, firms often deviate from making optimal investment decisions. Prior studies suggest that the main theoretical explanations for investment distortions are agency problems, i.e. the misalignment of managerial and shareholders' interests (Jensen and Meckling, 1976; Jensen, 1986), and asymmetric information between corporate insiders and the capital market (Myers and Majluf, 1984). Under the agency theory and asymmetric information theory, managers can derive private benefits from building corporate empires. This motives the managers to engage in self-maximizing behavior and toward over-investment. Alternatively, when a firm needs to raise funds to finance an investment, managers might refuse to raise funds even if that means letting go of good investment opportunities, and therefore lead to under-investment.

A large body of empirical literature supportive of both theories has investigated the determinants of firm investment efficiency. Biddle, Hilary and Verdi (2009) and Chen,

Hope and Wang (2011) suggest higher quality financial reports can mitigate information asymmetry problems, thereby improving investment efficiency. Gomarize and Ballesta (2014) find that firms with lower debt maturity are associated with both low over- and under- investment. Extending the findings that accounting conservatism improves investment efficiency (Bushman, Piotroski and Smith ,2011), Lara, Osma and Penalva (2016) document that accounting conservatism reduces under-investment via alleviating agency problems and mitigating firms' financing constraints. In addition, some recent work provides evidence that ownership type impacts firms' investment behavior and efficiency. Chen et al. (2014) examine the relationship between different ownership types and firm investment efficiency. They find that government and foreign ownership are associated with different level of agency problems and information asymmetry. They also find that foreign (government) ownership increases investment efficiency (inefficiency). Chen et al. (2011) also show that state-owned enterprises (SOEs) are associated with low investment efficiency and this effect is more pronounced when SOEs are politically connected through the employment of top executives with a government background. O'Toole, Morgenroth, and Ha (2016) discover that fully privatizing SOEs can improve capital allocation efficiency.

Another strand of literature shows that institutional investors could alleviate conflicts of interest between managers and shareholders and influence corporate governance decision through serval channels including monitoring management, voicing their opinions (Shleifer and Vishny, 1986, Agrawal and Mandelker, 1990) and threatening to

exit (Admati and Pfleiderer, 2009). There is a large empirical literature on the relationship between institutional shareholders and firm performance (Ferreira and Matos, 2008; Elysiani and Jia, 2010; Schmidt and Fahlenbrach, 2017), earnings management (Kim, et al., 2016), corporate risk-taking (Diez-Esteban, et al., 2016), financial distress likelihood (Manzaeque, Merino and Priego, 2016), financial reporting and information disclosure (Velury and Jenkins, 2006; Ramalingegowda and Yu, 2012, Ding et al., 2013), innovation activities (Aghion et al., 2013), mergers and acquisitions (Andriosopoulos and Yang, 2015) and international equity investment (Roque and Cortez, 2014). It is not clear, however, what the role of institutional ownership plays in capital allocation. Therefore, we complement previous studies by exploring how the institutional ownership impacts firms' investment behaviors and efficiency. Some previous studies suggest that not all institutional investors are equal, and different types of institutional investors can influence corporate governance and firm performance to different extents and in different ways (e.g. Brickley, Lease and Smith, 1998, Cornett, et al., 2007, Ferreira and Matos, 2008). Therefore, we also examine whether the type of institutional investor, i.e. pressure-resistant versus pressure-sensitive, has an impact on firm investment efficiency. In addition, we further examine how institutional ownership stability impacts the effect of institutional investors on investment efficiency, i.e. whether the effect of institutional investors on investment efficiency is increasing or decreasing with the institutional ownership persistence. As an extension of our research, we also attempt to identify through what channels institutional investors can affect firm investment efficiency.

For these purposes, we use Chinese publicly listed firm data for the period of 2009-2014 to examine the relationship between institutional ownership and investment efficiency. Evidence from China is of particular importance given that China is the most populated country and the world's largest emerging and transitional economy. The Chinese government has undertaken a series of important reforms to liberalize its capital market over the last two decades, such as opening the stock markets to qualified foreign institutional investors (QFIIs) and qualified domestic institutional investors (QDIIs), and launching the split-share structure reform. As a consequence, the institutional investors have been booming and playing an increasingly important role in the Chinese stock market[1]. Evidence shows that institutional investors can have positive effects in firms' decision-making process and in promoting effective governance mechanisms (Aggarwal et al., 2011), especially in capital markets where the legal system is at a developing stage and the protections to shareholders are comparatively weak. In addition, although investment efficiency in China has improved over time, over- and under-investments are still a pervasive problem in Chinese firms (Ding, Knight and Zhang, 2016). On one hand, a World Bank report points out that 75% of listed non-financial firms in China consider financial constraints as the main impediment to their investment and growth. This is the highest rate among 80 countries that were investigated (Claessens and Tzioumis, 2006). On the other hand, investment spending has significantly surged over the last decade and an overcapacity problem has

[1] The proportion of institutional shareholding in the markets has increased from 3% in 2004 to 33% in 2014 (Lin and Fu, 2017).

emerged in China (Lee, Syed and Liu, 2012). Overcapacity is not only in some traditional industries such as iron and steel, coal, glass, cement, aluminum, chemical, etc., but also in several emerging industries like solar panel and wind power generation equipment. According to Standard & Poor's report (2013), China has the highest investment-to-GDP ratio and low investment productivity among 32 of the world's largest economies over recent years - a sign of over-investment and deterioration in investment efficiency. The complex situation hinders Chinese economic development. Understanding institutional investors' influence on firms' corporate governance and investment efficiency in China may provide insights for understanding the roles different institutional investors play in settings of developing capital markets, and therefore, should be of strong interest to investors, regulators and academics.

Our analysis yields three key findings. First, we find that institutional ownership is positively associated with firm investment efficiency, suggesting that institutional investors play an effective role in mitigating information asymmetry and agency problems, thereby improving investment efficiency. Second, when we disaggregate institutional investors into pressure-resistant and pressure-sensitive groups, we find that only pressure-resistant institutional investors strongly enhance investment efficiency and this effect is more pronounced with high institutional ownership stability. Pressure-sensitive institutional ownership does not show a significant effect on investment efficiency. The results suggest that pressure-resistant investors are more long-term focused, and thus are more concerned with a firm's corporate governance and long-

term development, and more active in monitoring and engaging with management to effect changes. Third, we find that pressure-resistant institutional investors increase firm investment efficiency through three main channels: (1) by alleviating external financial constraints; (2) by reducing agency costs; and (3) by executive incentive compensation plans.

Our paper contributes to the corporate investment literature in three important ways. First, we contribute to the research by considering the influence of institutional ownership on firm investment efficiency. Second, our paper also contributes to the literature on the roles of institutional ownership in mitigating asymmetric information and agency problems. Our study considers the heterogeneity of institutional ownership from three dimensions including the size of institutional investors holding, independence and stability. In addition, our paper also explores the channels through which institutional investors affect investment efficiency, and provides a feasible path for firms to improve their investment decisions.

The remainder of the paper proceeds as follows. Section 2 develops the testable hypotheses. Section 3 describes the research design with models, measure of variables and the sample. Section 4 presents the empirical results and analysis. Finally, Section 5 concludes.

2 Hypothesis development

2.1 Institutional holdings and investment efficiency

The extant corporate investment literature has documented that the information asymmetry and agency problems are the main factors causing inefficiency in corporate investment. Myers and Majluf (1984) point out that the information asymmetry between managers and shareholders will affect the investment efficiency of an enterprise. Adverse selection and moral hazard can distort capital allocation function of the capital market, increase the cost of capital, and make it difficult for firms to raise funds for good investment opportunities. This leads to under-investment and entails a reduced firm value. Agency conflicts and information asymmetry exist when ownership and management separate. Shareholders can diversify their investment portfolios to eliminate unsystematic risk, and thus prefer to take riskier investment opportunities to maximize their return on investments. However, managers who have substantially more personal wealth tied up with one particular business are more risk averse. Managers, who know more about the value of a firm's assets and the information about investment opportunities than shareholders, would be in a better decision making position to refuse to invest in a good project, due to their personal risk aversion nature and information asymmetry. For example, managers might be reluctant to invest in innovation, research and development activities and are more focused on recouping short-term benefits rather than long-term development. The divergence between shareholders and managers' interests and the access to firm specific information makes managers "imperfect agents" who pass up good investment opportunities that would increase firm

value and shareholders' wealth (Easterbrook, 1984).

Managers also pursue their self-interest by overspending on investments that only negligibly benefit the shareholders or even at the cost of the shareholders. In scenarios such as liquidation, sell-offs, spin-offs, disinvestment, restructuring etc., shareholders can make better use of the money than managers who might use the money for "empire and reputation building" to gain remuneration for increasing firm size. Such investment in sub-optimal projects is for their own personal benefits rather than maximizing shareholders' wealth (Jensen, 1986).

Information asymmetry arises from conflicting interests between shareholders and managers, and makes it possible for "imperfect agents" to exploit shareholders. It can potentially damage the functioning of the capital market (Akerlof, 1970). Apart from the legal requirement that managers should fully and timely disclose relevant information, another potential solution to the information asymmetry is the involvement of information intermediaries in the capital market, who engage in accessing, processing and conveying management's superior information to the market (Healy and Palepu, 2001). Institutional investors are an information intermediary that effectively improve firms' disclosure quality (Shleifer and Visliny, 1997). Research shows that firms with greater institutional ownership and a long-term focus are more inclined to issue a forecast. Their forecast is more reliable with less biased optimism, and is more accurate, more detailed and more frequent (Ajinkya et al., 2005). Moreover, because of institutional investors' active involvement in portfolio firms' corporate governance and

their influence on managers' decision making, they have lower costs to acquire and easier access to information, and consequently are at an advantage to the market in processing information. (McCahery, Sautner and Starks, 2016). It is documented that institutional investors are more active traders around information disclosures than other investors. The market gains information from institutional investors' trading activities, which improves the information environment and reduces information asymmetry (O'Neill and Swisher, 2003). Evidence from the Chinese market also shows that share prices reflect institutional investors' trading activities and captures valuable firm information (Hou and Ye, 2008; Lei et al., 2012). Their trading behaviours and their influence on other investors' trading behaviours can significantly affect firms' market performance and market value. Given institutional investors' active involvement in corporate governance with managers, their effect on reducing information asymmetry, and the important role they play in the capital market, we argue that institutional investors can influence portfolio firms' corporate governance in regard to investment decisions and investment efficiency.

Institutional ownership also alleviates agency problems. Large institutional investors have incentives to monitor firms' operations and influence the management by actively participating in governance-related activities in order to achieve higher returns (Maug, 1998). Research shows that 63% of institutional investors choose to talk directly with the management or the board of directors of their portfolio firms. (McCahery, Sautner and Starks, 2016). Institutional investors' involvement in corporate governance reduces

managers' opportunistic self-interested and "window-dressing" behaviors, and effectively directs managers to focus on firms' long-term performance and improving corporate governance (Hadani et al., 2011; Eaton et al., 2014; Aggarwal et al., 2011). In particular, institutional investors with large holdings significantly improve firms' ability to innovate and induce management for the long-term (Aghion et al., 2013).

Not only can institutional investors improve a firm's governance and performance by actively participating in governance related activities, they can also improve a firm's governance through a passive way - voting with feet. When it is less costly to sell their stake than correcting management failure, institutional investors would choose an exit strategy. The impact on share prices by institutional selling can influence management decisions (Admati and Pfleiderer, 2009). Even if a manger is not concerned about the short-term stock price, the possibility that institutional investors disagree with the management and decide to exit the position improve the ability of an institutional investor to influence the managers (Levit, 2017). Parrino et al. (2003) document that institutional ownership significantly reduced in the year before a forced CEO turnover, which suggests that institutional investors "vote with their feet" when they are dissatisfied with management.

Based on the discussion above, we argue that institutional ownership can have significant influence on reducing information asymmetry and alleviating agency problems, and therefore hypothesize that institutional ownership, which can influence

managers' investment decisions, is positively associated with firm investment efficiency. Specifically, we form the following hypothesis:

H1: Institutional ownership can improve firm investment efficiency.

2.2 The independence of institutional investor and investment efficiency

Institutional investors vary in a number of dimensions. Their influence on management and corporate governance depends upon their investment horizons and their ties with management. With different incentives and conflicts of interests, institutional investors can be categorizes in to three categories based upon their relationship with management, that are, pressure-resistant institutions, pressure-sensitive institutions and pressure-indeterminate institutions (Brickley et al., 1988). The pressure-resistant institutional investors which have fewer business relationships with the portfolio firms have particular strong incentives to monitor management activities. Facing low conflicts of interests, they are more likely to vote against management on controversial issues. On the contrary, the pressure-sensitive institutional investors who want to protect the existing business or want to develop potential business relationships with their portfolio firms, are susceptible to pressures from management, and will passively play the shareholding role by either voting with the managers or holding shares without voicing their opinions on management decisions with which they disagree (Almazan et al., 2005; Aggarwal et al., 2011). The pressure-indeterminate institutional investors do not have business relations with the invested firms, however they are often categorized as

pressure-sensitive or passive investors due to the fact that they have small ownership and negligible monitoring effects on the invested firms. Therefore, we present the second hypothesis as follows:

H2a: Pressure-resistant institutional ownership improves firm investment efficiency.

H2b: Pressure-sensitive institutional ownership has no significant impact on firm investment efficiency.

2.3 Institution holding period and investment efficiency

Since pressure-sensitive institutional investors are susceptible to pressure from management and more agreeable to management decisions, such institutions' shareholding and the length of the holding period has limited effect on corporate governance and investment efficiency. However, pressure-resistant institutional investors, with fewer business involvements with invested firms, are more independent and more active in monitoring and influencing management to effect change. With a long(er) holding period, pressure-resistant institutional investors are more concerned about a firm's corporate governance and strategy and are more focused on a firm's long-term development rather than fishing short-term gains (Bebchuk, Brav, and Jiang, 2015). Moreover, the longer the holding period, the more reliable and more accurate information the institutional investors will learn about the portfolio firm, and consequently alleviates the information asymmetry between management and investors. Also institutions are more inclined to increase their holdings in portfolio firms which

they engage in monitoring on an ongoing basis. This shows institutional investors' dedication and the incentives to monitor management and to influence corporate governance (Chen et al., 2007). Long-term institutional investors are important to financial markets, because of the magnitude of their holdings and the influence of their trading activities on household investors. Research shows that long-term institutional investors attract more analysts and thus effectively reduce information asymmetry costs (Elyasiani and Jia, 2010). Taking into account the different behaviors and holding periods of institutional investors, we propose:

H3: The investment efficiency increases as the holding period of pressure-resistant institutional investors increases.

3 Research design

3.1 Variables

Investment efficiency

Following Biddle et al. (2009) and Shen et al. (2015), we define investment inefficiency as the difference between the actual and expected investments. Specifically, firms are considered to be over-investing (under-investing) if the actual investment is higher (lower) than the expected investment.

We estimate the expected investment based on the investment expectation model

proposed by Richardson (2006), and use the residuals generated by the model to measure the investment inefficiency. The model is specified as follows:

$$INV_{i,t} = \alpha_0 + \alpha_1 TQ_{i,t-1} + \alpha_2 CF_{i,t-1} + \alpha_3 LEV_{i,t-1} + \alpha_4 RETURN_{i,t-1} + \alpha_5 SIZE_{i,t-1} + \alpha_6 AGE_{i,t-1} + \alpha_7 INV_{i,t-1} + \sum \eta_j IND_j + \sum \delta_k YEAR_k + \varepsilon_{i.t} \quad (1)$$

where *i* and *t* denote the firm *i* at year *t*. The dependent variable, *INV*, is the investment expenditure of firm *i* at year *t*, which is defined as the ratio of the sum of the yearly growth in fixed assets, intangible assets and construction work in progress to the total assets. *TQ* is Tobin's Q as a proxy for growth and is calculated as the sum of the year-end market value of common stocks and the book value of total debt divided by the book value of total assets; *CF* is the ratio of the operating cash flows to the total assets, *LEV* is leverage measured by the total debt divided by the total assets; *RETURN* is the annual stock return; *SIZE* is the size of the firm measured by the natural logarithm of total assets; *AGE* is the number of listing years; *RETURN* is the annual stock return. We also control for industry (*IND*) and year (*YEAR*) effects on investment expenditure. The definitions and calculations for all the variables are presented in Table 1.

[*Insert Table 1 about here*]

The residuals from regression model (1) represent deviations from the expected investments. Following Gomariz and Ballesta (2014), our investment efficiency variable is measured by the absolute value of the residuals multiplied by -1, i.e.$-|\varepsilon_{i,t}|$.

A higher value of $-|\varepsilon_{i,t}|$ indicates a lower deviation from expected investment, and thus a higher investment efficiency. The investment efficiency variable purely measures a firm's investment efficiency level and does not differentiate between over- and under-investment. To provide a more comprehensive assessment of firms' investment behaviors, we also use the original residual values, ε, to measure over- and under-investment in our empirical tests. A positive (negative) residual indicates that a firm invests more (less) than expected, an over-investment (under-investment). Table 2 shows regression results generated by model (1). All variables are significant at the 1% level and the signs of the coefficients are consistent with prior research. The investment efficiency variable and the over- and under-investment can be calculated using the coefficients presented in Table 2.

[*Insert Table 2 about here*]

Institutional holdings

We define total Institutional ownership (*INST_ALL*) as the percentage of ordinary shares of a firm held by institutions at the end of each financial year. The institutional investors include qualified foreign institutional investors (QFII), domestic mutual funds, social insurance funds, pension funds, insurance companies, trusts, banks, financial companies and other investment companies. As discussed previously, considering the different nature of institutional investors who have different business ties with their portfolio firms, we follow Brickley et al. (1988) and classify institutional investors into two groups, pressure-resistant (*INST_PR*) and pressure-sensitive (*INST_PS*) investors. Pressure-resistant institutional ownership (*INST_PR*) is defined as the percentage of

shares of a firm held by QFII, domestic mutual funds, and social insurance funds. Pressure-sensitive institutional ownership (*INST_PS*) is defined as the percentage of shares of a firm held by banks, insurance companies, trusts, and other types of institutional investor[2]. In addition, research shows that the institutional holding period/stability has a significant impact on corporate management and investment decisions. Long-term investors participate in management issues more actively than short-term investors, and their engagements are primarily motivated by long-term focus about firms' corporate governance and development (McCahery et al, 2016). Therefore, following Elysaiani and Jia (2010), we use the institutional ownership persistence (*IOP*) proxy for institutional ownership stability, which is the ratio of the average ownership proportion to the standard deviation of the ownership proportion over a 5-year period (refer to Table 1 for details).

3.2 Model

We use the following model to test the three hypotheses proposed in section 2:

$$INVEFF_{i,t} = \beta_0 + \beta_1 INST_{i,t} + \beta_2 \mathrm{IOP}_{i,t} + \beta_3 OREC_{i,t} + \beta_4 FCF_{i,t} + \beta_5 RMCOST_{i,t} + \beta_6 SIZE + \sum \theta_j IND_j + \sum \chi_k YEAR_k + \omega_{i,t} \quad (2)$$

[2] Brickley et al. (1988) categorize institutional investors into pressure-resistant, pressure-sensitive and pressure-indeterminate groups. Institutional investors such as pension funds, investment consulting firms etc. are considered pressure-indeterminate investors. These investors generally hold a small proportion of companies' shares (less than one percentage) and are not actively monitoring firms' management and thus have limited effect on a firms' management. Therefore, we classify them as pressure-sensitive institutional investors for our research purpose. Ferrira and Matos (2008) categorize institutional investors as independent and grey institutional investors. Almazan et al. (2005) refer to them as active and passive investors respectively.

where *INVEFF*, as previously defined, measures investment efficiency which is obtained from the residuals from model (1). *INST* refers to total institutional ownership (*INST_ALL*) in the test for H1, and pressure-resistant (*INST_PR*) in the test for H2a and pressure-sensitive institutional ownerships (*INST_PS*) in the test for H2b. Based on our hypotheses, we expect the coefficients of *INST_ALL*, *INST_PR* and *IOP* to be positive and statistically significant. Following previous research, we also control for factors that can potentially affect investment efficiency. First, a higher major shareholders' claimant (*OREC*) leaves less funds available for investment and leads to under-investment. Research also shows that shareholders with high controlling ownership have more incentives and are more powerful in distorting firms' investments to benefit themselves at the cost of expropriating minority shareholders (Jensen, 1986; Wei and Zhang, 2008). *OREC* is the ratio of other receivables to total assets, controlling the influence of major shareholders on investment efficiency. Second, the effect of free cash flow, *FCF*, is controlled, as ample cash provides more financial resources to investments and potentially alleviates under-investment problems, but also likely leads to over-investment problems (Richardson, 2006). Third, driven by self-interest, a manager's investment decisions might harm a firm's investment efficiency (Ang et al., 2000). We therefore include the overhead expense ratio (*RMCOST*), the ratio of a firm's operating expenses to its operating income, as a proxy for agency costs to control the agency effect on investment efficiency. Fourth, as previous studies find that larger firms have more access to resources to finance their investments, and are arguably more mature and more experienced in corporate governance and investments (Whited and

Wu, 2006), our model controls firm size (*SIZE*) effect on firm investment efficiency. We also include year and industry dummies to control the impact of macroeconomic change over time and unobservable industry heterogeneity. Table 1 presents a summary of the variable definitions. We estimate the model by OLS with clustering at the firm level. In addition to the OLS regression estimation, we also use the generalized method of moment (GMM) and three-stage least squares (3SLS) estimations to address the possible endogeneity problems as a robustness check (see section 4.3).

3.3 Data

Considering the influence of Split Share Structure Reform[3] and the implementation of new accounting standards in 2007, our sample includes the A-share firms listed on the Shanghai and Shenzhen stock exchanges from 2009 to 2014 excluding financial firms, special treatment (ST) firms and observations with missing data. This results in a sample of 8,372 observations. We winsorize all the continuous variables at 1% and 99%. Data used in this study are collected from the CSMAR database.

4 Empirical Results

4.1 Descriptive statistics

[3] Before the Split-Share Structure Reform (SSSR) took place in 2005, the Chinese government withheld control of the listed state-owned enterprises (SOEs), and owned non-tradable shares. Non-tradable shares, which are different from tradable shares held by public investors, are prohibited from being traded in the secondary market. Since the executives of SOEs were compensated based on the price of non-tradable shares, i.e. the book value of firm net assets, rather than the market value of the firm's tradable shares, and were not able to benefit from any capital gains, they had no interest in the firm's market value of equity, or the stock market risks faced by public investors. The introduction of the SSSR, however, which aims to convert non-tradable shares in to tradable shares, is expected to align the interests of state owners more with private owners, and to motivate executives of SOEs to improve a firm's market performance (Liao, Liu and Wang, 2014).

Table 3 presents sample descriptive statistics. The firm investment efficiency, *INVEFF*, has a mean (median) value of -0.0466 (-0.0299), and a standard deviation of 0.0643. Note in particular that the inefficient investment, ε, has a minimum (maximum) value of -1.7311 (0.7889) and a mean (median) value of 0.0002 (-0.0100). The statistics suggest that overall, over-investment is severe in China, although most of the observations under-invest over the sample period from 2009 to 2014, which is consistent with the findings in prior research (Xin et al., 2007; Gomariz and Ballesta, 2014). There are about 7.7% shares held by institutional investors, of which 3.6% are held by pressure-resistant institutional investors and 4.1% are held by pressure-sensitive institutional investors. The pressure-resistant institutional ownership, with a standard deviation of 0.0428, is interpreted as a more stable ownership than pressures-sensitive institutional ownership which has a standard deviation of 0.0931. The stability of pressure-resistant institutional ownership, *IOP*, has a standard deviation of 1.7890, suggesting a substantial difference of holding stability among pressure-resistant institutional investors. The statistics of other variables summarized in Table 3 are to be similarly interpreted.

[*Insert Table 3 about here*]

4.2 Correlation analysis

Table 4 reports the Pearson correlation matrix for the main variables. While multicollinearity is a common issue in corporate governance research (Brown et al. 2011), it is unlikely that multicollinearity is a major issue in our study, as the highest

correlations between variables included in the same regression is 0.383 between *INST_PR* and *IOP*. The correlations between the pressure-resistant institutional shareholdings, *INST_PR*, and investment efficiency, *INVEFF*, and the correlations between pressure-resistant holding stability, *IOP*, and *INVEFF*, are significantly positive as predicted. Neither the institutional shareholdings, *INST*, nor pressure-sensitive institutional shareholdings, *INST_PS*, show significant relationship with *INVEFF*. The correlations suggest that percentage of shareholding by pressure-resistant institutional investors and a long and stable ownership are positively associated with firm investment efficiency, and pressure-resistant institutional investors tend to hold shares for a longer term. The agency costs (*RMCOST*) are significantly and negatively related to investment efficiency, suggesting high agency costs deter firms from optimal investments. Free cash flow (*FCF*) and firm size (*SIZE*) are significantly and positively related to investment efficiency. As expected, major shareholder claimant (*OREC*) shows a negative association with investment efficiency. However, the interpretations of the correlations table is only preliminary, we leave the formal interpretations of our results to the multivariate analysis.

[*Insert Table 4 about here*]

4. 3 Main results

Table 5 presents the results of model (2) that examines the relationship between institutional holdings, *INST*, pressure-resistant holdings, *INST_PR*, pressure-sensitive holdings, *INST_PS*, pressure-resistant holding stability, *IOP*, and firm investment

efficiency, *INVEFF*, respectively[4]. Column (1) shows that *INST* is positively related to *INVEFF* at 10% significance. In terms of economic magnitude, when total institutional holdings increase by 1%, investment efficiency will increase by 0.24% (0.011/0.0466). The results support H1 and suggest that institutional holdings improve firm investment efficiency, although we acknowledge that the test results presented in Table 5 do not indicate causal relationship, a point that we address later.

Column (2) reports the relationship between *INST_PR*, *INST_PS* and *INVEFF*. The results show that *INST_PR* strongly enhances firm investment efficiency. Specifically, when pressure-resistant holdings increase by 1%, firm investment efficiency will improve by 1.09% (0.051/0.0466). The results capture the incremental effect of pressure-resistant ownership on investment efficiency, and suggest that pressure-resistant institutional investors' effective monitoring has a positive impact on firm investment efficiency. Hence H2a is supported. On the contrary, the pressure-sensitive institutional ownership does not show significant effect on investment efficiency. The results support H2b and suggest that pressure-sensitive institutional investors are likely to be agreeable to management, or their ownership is not strong enough to effectively influence the management's decisions on investment.

[4] We use the industry median value of institutional ownership to separate the sample into two groups. The group of firms with institutional ownership above the median are considered as high institutional ownership firms and those with institutional ownership lower than the median are considered as high institutional ownership firms. We also re-run the baseline regressions models based on two sub-samples. We find a significantly positive relationship between total institutional ownership (pressure-resistant institutional ownership) and investment efficiency for the firms with high institutional ownership. These findings echo our previous results from the full sample. The robustness test results are omitted for brevity but available from the authors upon request.

Column (3) provides the results of the influence of pressure-resistant holding stability, *IOP*, on investment efficiency, *INVEFF*. The results support H3 and show that the investment efficiency increases as the holding stability of pressure-resistant institutional investors increases. The significant relationship between stability and firm investment efficiency suggests that when institutional investors have a long-term investment in a firm, the institutional investors are more focused on sustainable long-term development of the firm. This finding also supports the view that long-term investors are more engaged with effecting changes and disciplining management, as they are more concerned about the invested firm's corporate governance and future growth rather than reaping the short-term gains from speculation (Bebchuk, Brav and Jiang, 2015).

[*Insert Table 5 about here*]

The results presented in column (2) and (3) in Table 5 motivate us to investigate further, as discussed in section 2.4, whether pressure-resistant and pressure-sensitive institutional shareholdings and their stability alleviate either or both under- and over-investment. We divide our sample data into two sub-samples, the under-investment sub-sample, where $\varepsilon_{i,t}<0$, and the over-investment sub-sample, where $\varepsilon_{i,t} > 0$, and apply model (2) to both samples. Column (1) in Table 6 shows that, in general, institutional ownership can alleviate under-investment problems, and has no significant impact on over-investment. Column (2) shows that pressure-resistant institutional ownership can significantly alleviate both under- and over- investment, while pressure-sensitive

institutional investors do not show any significant association with either under- or over-investment. The results indicate that not all institutional ownership can improve investment efficiency. Pressure-resistant institutional investors who have less business ties with the portfolio firms are more likely to actively monitor management, induce changes and to promote a better governance and more efficient investments. Pressure-sensitive institutional investors, however, are inclined to agree with managers' decisions in order to protect the existing and potential business relations that they have with portfolio firms. They do not play an active role in governance, and are more reluctant to voice their opinions on managers' investment decisions. Column 3 in table 6 also shows that higher stability of pressure-resistant institutional ownership alleviates over-investment problems. Note that the adjusted R squares, the explanatory power of the models, are significantly higher for the under-investment models than the over-investment models. The higher explanatory power of the under-investment models suggests that pressure-resistant institutional investors effectively reduce, in particular, under-investment problems. As discussed before, under-investment may be a result of agency conflicts, as managers, who have their careers, reputations and substantially more personal wealth tied up with one particular business, are more risk averse than investors, and are more likely to pass up good investment opportunities. The significant and negative associations between *RMCOST* and under-investment in Table 6 also support our agency costs interpretation.

We notice that in Table 5 *OREC* is not significantly associated with investment

efficiency; however, *OREC* becomes highly significant in Table 6 after we distinguish over-investment and under-investment activities. The results support our argument that firms with a high *OREC* are more likely to have cash constrains, and are more likely to under-invest rather than over-invest. Turning to our other control variables, we find that free cash flow, *FCF*, significantly increases firm investment efficiency (as shown in Table 5), in particular by alleviating under-investment (as shown in Table 6). Finally, as discussed before, firm size plays a significant role in firm investment efficiency (as shown in Table 5). Large firms which have more access to funds, are less likely to have under-investment problems (as shown in Table 6). They are also less likely to over-invest, as large firms are arguably more likely to have an established and mature governance mechanism to restrain over-investment. Our findings are consistent with prior research findings (Whited and Wu 2006, Deng and Zeng 2014).

[*Insert Table 6 about here*]

4.4 Endogeneity

We acknowledge that endogeneity, particularly reverse causality and bi-directional causality, are potential concerns of our study, and may confound our tests. We conduct two additional tests to address such concerns. First, to explicitly address the reverse causality (where institutional investors are attracted to firms with high investment efficiency), we perform the Generalized Moment estimation Method (GMM), for which the natural logarithm of the market value of trading shares, *CIRMV*, and turnover rate, *TURNOVER*, are used as the instrumental variables for institutional ownership

variables. Prior research finds that institutional investors prefer investing firms with high market value, *CIRMV,* and low turnover rate, *TURNOVER*. However, *CIRMV* and *TURNOVER* are unlikely to directly affect firm investment efficiency, which satisfies the exclusion condition of instrumental variables (Hou and Ye 2008, Elyasiani and Jia 2010). To provide additional support to our choice of instruments in the GMM test, we conduct the Sargan-Hansen over-identifying restrictions test to examine the exogeneity of the instrumental variables. Hansen J-statistics ($p = 0.6827$) suggest that at least one instrumental variable does not violate the over-identifying restrictions. The Kleibergen - Paaprk Wald F-statistic value is 399.685, rejecting the null hypotheses that the instrumental variables are weak and confirming the relevance of our instrumental variables to institutional ownership. Column (1) in Table 7 reports the GMM results. Consistent with the results presented in Table 6, pressure-resistant institutional ownership is significantly positively related to firm investment efficiency. The above analysis shows that our findings are supported after controlling the reverse causality.

Second, in order to address bi-directional causality concern (where institutional investors improve firm investment efficiency which in turn attracts more institutional investors), we construct the following simultaneous equations (equations 3 and 4) and use three stage least square regressions (3SLS):

=

$$INVEFF_{i,t} = \beta_0 + \beta_1 INST\_PR_{i,t} + \beta_2 INST\_PS_{i,t+} + \beta_3 OREC_{i,t} + \beta_4 RMCOST_{i,t} + \beta_5 FCF_{i,t} + \beta_6 SIZE_{i,t} + \sum YEAR + \sum IND + \xi_{i,t} \quad (3)$$

$$INST\_PR_{i,t} = \alpha_0 + \alpha_1 INVEFF_{i,t} + \alpha_2 OREC_{i,t} + \alpha_3 RMCOST_{i,t} + \alpha_4 SIZE_{i,t} + \alpha_5 CIRMV_{i,t} + \alpha_6 TURNOVER_{i,t} + \sum YEAR + \sum IND + \mu_{i,t} \quad (4)$$

The instrumental variables *CIRMV* and *TURNOVER* are included in equation (4)[5]. The regression results in Column (2) and (3) in Table 7 show that the pressure-resistant institutional ownership has a significant positive influence on firm investment efficiency, whilst firm investment efficiency does not show a significant influence on pressure-resistant institutional ownership. The results in Table 7 suggest that bi-directional is negligible. The results are also consistent with prior studies and show that pressure-resistant institutional ownership has a significant positive correlation with *CIRMV*, and a negative correlation with *TURNOVER* (Elyasiani and Jia, 2010).

[*Insert Table 7 about here*]

4.5 Potential effect channels

Our findings from the previous section support a causal relation between pressure-resistant institutional ownership and firm investment efficiency. In this section, we explore the possible channels through which institutional investors exert impacts on firm investment efficiency. The most prominent frictions that lead to under- or over-

[5] We remove *FCF* from equation (4), as it has no significant relationship with institutional ownership, and provides noisier parameter estimates.

investment, as discussed previously, are information asymmetry and agency conflicts. In this section we specifically examine whether pressure-resistant institutional ownership can improve firm investment efficiency via mitigating information asymmetry and agency conflicts by 1) alleviating external financing constraints, 2) reducing agency costs, and 3) influencing executive incentive compensation plans.

External financing constraints

Due to the "imperfections" of capital markets, internal financing has multiple advantages over external financing. However, after exhausting internal financing options, firms raise funds externally. Due to information asymmetry, external funds are with high cost of capital and are likely to be insufficient, which potentially leads to under-investment (Fazzari et al., 1988). In addition, for firms with a debt over-hang problem, investment opportunities with a positive net present value may not be attractive to shareholders, given the additional risk involved. However, the rejection of good investment opportunities is against creditors' expectations, and thus leads to under-investment problems and a further increase in the cost of debt financing (Myer, 1977).

Previous literature shows that institutional ownership can reduce information asymmetry between insiders and external investors, and thus reduce external financing constraints and cost of capital (Goergen and Renneboog, 2001). It is also documented that institutional ownership effectively monitors portfolio firms' financial structures

and reduces sub-optimal leverage. Particularly, the pressure-resistant institutional investors, which are less likely to have business ties with the portfolio firms, have more pronounced monitoring effects on firms' leverage, especially, in an environment with high information asymmetry (Chung and Wang, 2014). Given the effects that pressure-resistant institutional ownership can have on a firm's financial structure and information and financing environment, we examine if pressure-resistant institutional investors improve firm investment efficiency via easing external financing constraints. Following Musso and Schiavo (2008), we use the enterprise credit characteristics to measure the degree of external financing constraints, or the ease of the access to external funds. The proxy for external financing constraints, *EFC*, is defined in Table 1.

Management efficiency

Inefficient investment decisions may be driven by managers' desire for self-aggrandizement. On one hand, according to the agency theory, managers have the incentive to overspend for empire building with ample capital, which leads to over-investment. On the other hand, managers are also expected to be risk-averse, as their prospects are generally tied to the single business they work for. One way for managers to reduce risk is to pass up risky opportunities, which would otherwise benefit shareholders (John et al., 2008).

Inefficient investment, however, can be mitigated by increasing investors' ability to

monitor managerial investment decisions. Institutional investors, given the size of their equity stake, long-term focus, and their engagement with management of portfolio firms, have motivation and ability to monitor and discipline managers' opportunistic behaviors and improve investment efficiency. In particular, institutional investors' threat of exit exerts pressure on managers, who are concerned about reputation enhancement, job security and any incentive payments that may emanate from shareholders' confidence. Hence, institutional investors' engagement with management to affect changes, and their exiting strategy to discourage managers' self-interested behaviors, reduces agency costs and potentially increases investment efficiency. We therefore argue that the active role pressure-resistant institutional ownership plays in corporate governance can effectively improve investment efficiency through increasing management efficiency. Following Ang et al. (2000), our paper uses asset efficiency ratio to measure management efficiency and agency costs. The efficiency ratio, *REV*, is defined in Table 1.

Executive incentive compensation plan

Previous studies show that a well-designed executive incentive compensation plan can improve management efficiency, in particular, when keeping executive and shareholder interests integrated and aligned (Jensen and Murphy 1990, Bergstresser and Philippon 2006). When managers' remuneration and compensation heavily depend upon firm performance, managers may be tempted to spend on sub-optimal projects to achieve short-term performance goals by reducing, for example, R&D expenditure, which may

lead to negative long-term consequences.

One way to address managers' myopia is by linking managerial pay to shareholder value in the remuneration and compensation plan. Prior literature shows that when managers' compensation is linked to share price fluctuations, managers prefer riskier ventures with higher returns, which is in line with shareholders' preferences (Coles et al., 2006). The effective use of a remuneration and compensation plan requires more careful design and greater influence and oversight from shareholders on investment decisions to minimize executives misallocating resources and gaming of reported performances to meet short-term goals. Institutional investors, given their involvement with management, are in a better position than household investors to influence a firm's executive remuneration and compensation plan. Firstly, institutional investors with large shareholdings can nominate independent directors who have a significant influence on the compensation and appointment of executives. Secondly, institutional shareholders can induce their design and changes to a remuneration and compensation plan by using the threat of exit, making the plan more in line with shareholders' interests (Hartzell and Starks 2003). Since an active institutional ownership can have a significant influence on executive remuneration and compensation to cater shareholders' interests, we argue that pressure-resistant institutional ownership can improve firm investment efficiency via participating in designing and changing executive remuneration and compensation plans. The definition of *EXEC*, the proxy for the executive incentive compensation plan, is presented in Table 1.

Given the mediation effects that external financing constraints, agency costs and executive incentive compensation plans can have on firm investment efficiency, we construct the following simultaneous equations (Mackinnon et al., 2002) to test the mediation effects:

$$INVEFF_{i,t} = \beta_0 + \beta_1 INST\_PR_{i,t} + \sum_j \beta_j Control_j + \sum YEAR + \sum IND + \xi_{i,t} \quad (5)$$

$$MEDIATOR_{i,t} = \theta_0 + \theta_1 INST\_PR_{i,t} + \sum_j \theta_j Control_j + \sum YEAR + \sum IND + \delta_{i,t} \quad (6)$$

$$INVEFF_{i,t} = \varphi_0 + \varphi_1 INST\_PR_{i,t} + \varphi_2 MEDIATOR_{i,t} + \sum_j \varphi_3 Control_j + \sum YEAR + \sum IND + \tau_{i,t} \quad (7)$$

Where external financing constraints, *EFC*, agency costs, *REV*, and the executive incentive compensation plan, *EXEC*, are the mediator variables, *MEDIATOR*. For equation (5), if β_1 is greater than 0, it shows that pressure-resistant institutional ownership enhances firm investment efficiency. If θ_1 and φ_2 are significant while φ_1 is insignificant, then the mediator variable has a full mediation effect. If either one of θ_1 and φ_2 is insignificant, we need to examine the mediation effect of the mediators by using the Sobel-Goodman test.

The results are presented in Table 8. Column (1) and (2) provide regression results by using external financing constraints, *EFC*, as the mediator variable. The coefficient of

INST_PR in Column (1), generated by equation (6), is highly significant and greater than zero, showing that pressure-resistant institutional ownership reduces the external financing constraints. The coefficients of *INST_PR* in Column (2), generated by equation (7), becomes insignificant when *EFC* is added to the regression, suggesting that the external financing constraint has a full mediation effect. The Sobel-Goodman mediation effect test shows that z = 8.591 which is significant at the 1% level, indicating that the effect pressure-resistant institutional ownership, *INST_PR*, has on firm investment efficiency, *INVEFF*, can be attributable to pressure-resistant institutional investors, effectively reducing a firm's external financing constraints.

Column (3) and (4) provide regression results using the agency costs, *REV*, as the mediator variable. The coefficient of *INST_PR* in Column (3), generated by equation (6), is highly significant and greater than zero, suggesting that pressure-resistant institutional ownership significantly improves management efficiency. The coefficients of *REV* and *INST_PR* in Column (4), generated by equation (7), are highly significant and greater than zero, showing management efficiency partially mediating the relationship between pressure-resistant institutional ownership and investment efficiency. The Sobel-Goodman mediation effect test shows that 16.40% of the effect that pressure-resistant institutional ownership, *INST_PR*, has on firm investment efficiency, *INVEFF*, is attributable to the management efficiency.

Column (5) and (6) report regression results using the executive incentive compensation

plan (*EXEC*) as the mediator variable. In Column (5), the coefficient of *INST_PR*, generated by equation (6), was significant and greater than zero, showing that pressure-resistant institutional ownership significantly increases the alignment between managerial pay and shareholder interests. The coefficients of *EXEC* and *INST_PR* in Column (6), generated by equation (7), are also significant and greater than zero, which shows that executive incentive plays a partial mediating role between pressure-resistant institutional ownership and investment efficiency. The Sobel-Goodman mediation effect test shows that 19.16% of the effect that pressure-resistant institutional ownership, *INST_PR*, has on firm investment efficiency, *INVEFF*, is attributable to the executive incentive compensation plan. While prior literature documents the roles that institutional investors play in influencing portfolio firms' executive remuneration and compensation schemes (e.g. Hartzell and Starks 2003), we do not empirically test the influence of different activities they participate in on the schemes in this study. We leave a more thorough examination to future research.

4.6 Additional tests

In order to take in to account the different natures of institutional ownerships, we use various kinds of institutional ownerships as the explanatory variables to test the influences that they may have on firm investment efficiency. Our untabulated results show that domestic mutual funds and social insurance funds, which are the pressure-resistant institutional ownerships, significantly improve investment efficiency; while bank holdings significantly decrease investment efficiency. We also find that insurance

company holdings, trust holdings and financial firm shareholdings are negatively related to firm investment efficiency; while non-financial firm shareholdings and Qualified Foreign Institutional Investors (QFII) holdings are positively related to firm investment efficiency. However, the relationships are not statistically significant. Note that QFII does not show a significant relationship with firm investment efficiency, suggesting China's QFII does not significantly influence firms' investment decisions. In general, the results support the previous findings that pressure-resistant institutional ownership can have a significant positive impact on firm investment efficiency.

In addition, to test the robustness of our results on over- and under-investment, we sort the value of the residuals, ε, generated by model (1), from high to low and equally divide them into three groups. We remove the middle group which contains firm-year observations with negligible deviations from the expected investment expenditure, and keep the top and bottom groups which contain firm-year observations with the highest and lowest residuals, respectively. Therefore, over-investment (under-investing) occurs in the top (bottom) group. The untabulated results based on this new classification are consistent with the results presented in Table 6.

5. Conclusion

In this paper, we empirically examine the influence of institutional ownership on firm investment efficiency. We find that first, institution ownership in general, improves the

firm investment efficiency; second, after considering the business ties institutional investors have with the portfolio firms, we find that only pressure-resistant institutional investors, who are more independent and have less business ties with the portfolio firms, improve firm investment efficiency by alleviating under- and over-investment problems; while the pressure-sensitive institutional investors, who are more dependent on the business relationship with the portfolio firms, do not have a significant influence on firm investment efficiency. Third, after considering the influence of the holding period of pressure-resistant institutional ownership, we find that pressure-resistant institutional investors' long-term focus increases portfolio firms' investment efficiency. In addition, when pressure-resistant institutional investors hold portfolio firms' shares for a longer term, they tend to increase the size of their shareholdings. Last, we find that alleviating external financing constraints, increasing management efficiency, and influencing executive incentive compensation plans, are important channels for pressure-resistant institutional investors to improve portfolio firm investment efficiency.

Our findings shed light on the relationship between institutional ownership and investment efficiency. We add to this strand of literature by disaggregating institutional investors into different types depending on their impediments to engagement, principally because of the protections to the existing or potential business relationships with the portfolio firms. Our findings are consistent with the theoretical literature on agency theory and information asymmetry, and help investors, regulators and academics understand institutional investors' behaviors and strategy that can be used to

align management interests with shareholder value, and monitor management to alleviate agency costs and improve resource allocation efficiency.

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Table 1: Variable definitions

INV	The ratio of the sum of the yearly growth in fixed assets, intangible assets and construction work in progress to the total assets.
TQ	Tobin Q: the sum of market value of tradable shares, book value of non-tradable shares and liabilities divided by book value of total assets
CF	The ratio of the operating cash flows to the total assets
LEV	Leverage：total liabilities divided by total assets
RETURN	Stock performance: adjusted buy-and-hold market returns measured over year t
SIZE	Firm size：natural logarithm of total assets
AGE	Firm age：Sample year minus list year plus 1
ε	Inefficient investment： regression residual generated by equation 1
INVEFF	Investment efficiency：the absolute value of equation 1 regression residual multiplied by -1
INST	Institutional ownership：percentage of number of ordinary shares owned by institutional investors
INST_PR	Pressure-resistant institutional ownership： percentage of number of ordinary shares owned by pressure-resistant institutional investors
INST_PS	Pressure-sensitive institutional ownership：percentage of number of ordinary shares owned by pressure-sensitive institutional investors
IOP	The stability of pressure–resistant ownership type[6]
FCF	Free cash flow： Net profit plus interest expense and non-cash items less the increase in working capital and capital expenditure, scaled by total assets
OREC	large shareholder claimant：other receivables scaled by total assets
RMCOST	Overhead expense rate：overhead expense divided by operating income
EFC	External financing constraints[7]
REV	Revenue： total revenue scaled by total assets
EXEC	Executive incentive：Dummy variable and it equals to 1 when the firm-year observation implements executive incentives plan and 0 otherwise
CIRMV	Natural logarithm of market value of equity
TURNOVER	Annual turnover /the total number of tradable shares
IND	Industry dummy variables: according to CSRC classification standard, 17 industry dummy variables are included to control for unobservable industry effects.
YEAR	Year dummy variables which are included to control for macroeconomic changes over time.

[6] Defining the range of the five years to compare FUND stability：

$IOP\_FUND = \frac{FUND_{i,t}}{\sigma(FUND_{i,t-4}, FUND_{i,t-3}, FUND_{i,t-2}, FUND_{i,t-1}, FUND_{i,t})}$，QFII holding and SECURITY holding is calculated similar to fund stability. Pressure resistance type institutional ownership persistence (IOP) is the mean value of the fund, QFII shareholding and shareholding sustainability of social security. The greater the IOP, the higher stability, i.e. the longer term shareholdings.

[7] Following Musso and Schiavo (2008), Yang (2012) and Luo and Chen (2012), we use enterprise credit characteristics and select five variables/dimensions to measure external financing constraints. The five variables/dimensions are firm size, net tangible assets to total assets ratio, solvency, liquidity ratio, debt to asset ratio and return on assets. For each of these five variables/dimensions, and each year, we rank the values/ratios from low to high and place the value/ratio in one of the quintiles. Then we calculate the average score of the five dimensions. A higher score, *EFC*, implies an easier access to external funds.

Table 2: Regression results of expected investment model

$TQ_{i,t-1}$	$CF_{i,t-1}$	$LEV_{i,t-1}$	$RETURN_{i,t-1}$	$SIZE_{i,t-1}$	$AGE_{i,t-1}$	$INV_{i,t-1}$	*Adj-R2*
0.003***	0.035***	-0.019***	0.006***	0.002***	-0.001***	0.276***	0.146
(0.001)	(0.006)	(0.005)	(0.002)	(0.001)	(0.000)	(0.010)	

Table 2 reports correlations on variables that determine firm-year expected investment. See Table 1 for variable definitions. The signs of *,** and*** denote significance at the 1%, 5% and 10% levels, respectively.

Table 3: Descriptive statistics of main variables

Variables	N	Mean	Sd	Min	Med	Max
INVEFF	8372	-0.0466	0.0643	-1.7310	-0.0299	0.0000
ε	8372	0.0002	0.0794	-1.7311	-0.0100	0.7889
INST	8372	0.0771	0.1020	0.0016	0.0462	0.5840
INST_PR	8372	0.0357	0.0428	0.0000	0.0197	0.1950
INST_PS	8372	0.0412	0.0931	0.0000	0.0104	0.5510
IOP	7947	1.2830	1.7890	0.0000	0.9840	15.9300
OREC	8372	0.0171	0.0289	0.0000	0.0085	0.5850
RMCOST	8372	0.0925	0.0921	0.0017	0.0726	2.1350
FCF	8372	0.0004	0.1230	-2.7290	0.0149	3.0480
SIZE	8372	22.1800	1.2800	19.2900	22.0200	25.7500

Note: Table 3 presents descriptive statistics for main variables included in regressions.

Table 4 Correlation matrix

	INVEFF	*INST*	*INST_PR*	*INST_PS*	*IOP*	*OREC*	*RMCOST*	*FCF*	*SIZE*
INVEFF	1								
INST	0.014	1							
INST_PR	0.032***	0.407***	1						
INST_PS	0.000	0.903***	-0.020*	1					
IOP	0.025**	0.124***	0.383***	-0.043***	1				
OREC	-0.007	-0.036***	-0.032***	-0.027**	-0.007	1			
RMCOST	-0.096***	-0.026**	-0.0100	-0.024**	0.052***	0.113***	1		
FCF	0.132***	-0.045***	-0.019*	-0.040***	0.003	-0.036***	-0.033***	1	
SIZE	0.082***	0.046***	-0.026**	0.063***	-0.014	-0.085***	-0.343***	0.027**	1

Notes: Table 4 reports Pearson correlations for main variables. See Table 1 for variable definitions. The signs of *,** and*** denote significance at the 1%, 5% and 10% levels, respectively.

Table 5: Institutional holdings and firm investment efficiency

	INVEFF		
	(1)	(2)	(3)
$INST_{i,t}$	0.011*		
	(1.78)		
$INST\_PR_{i,t}$		0.051***	0.034**
		(3.21)	(2.03)
$INST\_PS_{i,t}$		0.003	0.005
		(0.51)	(0.84)
$IOP_{i,t}$			0.001**
			(2.32)
$OREC_{i,t}$	-0.026	-0.023	0.003
	(-0.73)	(-0.67)	(0.09)
$RMCOST_{i,t}$	-0.055***	-0.055***	-0.040***
	(-2.77)	(-2.76)	(-2.61)
$FCF_{i,t}$	0.071***	0.071***	0.070**
	(2.94)	(2.94)	(2.43)
$SIZE_{i,t}$	0.003***	0.003***	0.003***
	(4.69)	(4.69)	(5.49)
Constant	-0.114***	-0.116***	-0.121***
	(-7.31)	(-7.39)	(-8.47)
YEAR	control	control	control
IND	control	control	control
N	8372	8372	7947
F	26.60***	25.60***	23.67***
Adj_R2	0.067	0.068	0.060

Table 5 reports the regression results for the effect of institutional holdings on firm investment efficiency. See Table 1 for variable definitions. Year fixed effects and industry fixed effects are included in the model. The sign of *, ** and *** denote significance at the 10%, 5% and 1% levels, respectively. Robust standard errors are in parentheses. Robust standard errors clustered at the firm level are used to address issues of heteroscedasticity and correlated error terms across firms and/or across time.

Table 6：Institutional holdings and over-/under-investment

	(1)		(2)		(3)	
	$\varepsilon_{i,t}<0$	$\varepsilon_{i,t}>0$	$\varepsilon_{i,t}<0$	$\varepsilon_{i,t}>0$	$\varepsilon_{i,t}<0$	$\varepsilon_{i,t}>0$
$INST_{i,t}$	0.016***	-0.007				
	(2.58)	(-0.61)				
$INST\_PR_{i,t}$			0.066***	-0.059**	0.057***	-0.031
			(3.71)	(-2.17)	(3.15)	(-1.06)
$INST\_PS_{i,t}$			0.007	0.003	0.007	-0.003
			(1.15)	(0.25)	(1.11)	(-0.24)
$IOP_{i,t}$					0.000	-0.001*
					(0.70)	(-1.93)
$OREC_{i,t}$	-0.123***	-0.189***	-0.120***	-0.191***	-0.107**	-0.213***
	(-2.67)	(-3.80)	(-2.61)	(-3.83)	(-2.36)	(-3.36)
$RMCOST_{i,t}$	-0.061**	0.039	-0.060**	0.039	-0.030*	0.051*
	(-2.34)	(1.58)	(-2.34)	(1.57)	(-1.91)	(1.72)
$FCF_{i,t}$	0.102***	-0.014	0.102***	-0.014	0.111**	-0.012
	(2.73)	(-0.77)	(2.73)	(-0.77)	(2.36)	(-0.63)
$SIZE_{i,t}$	0.005***	-0.002**	0.005***	-0.003**	0.005***	-0.002*
	(6.36)	(-2.23)	(6.33)	(-2.32)	(8.63)	(-1.85)
Constant	-0.134***	0.124***	-0.135***	0.130***	-0.147***	0.119***
	(-7.46)	(4.86)	(-7.49)	(5.04)	(-9.70)	(4.51)
YEAR	control	control	control	control	control	control
IND	control	control	control	control	control	control
N	5032	3340	5032	3340	4733	3214
F	22.68***	12.58***	21.84***	12.05***	22.20***	11.01***
Adj_R^2	0.145	0.053	0.147	0.053	0.138	0.051

Table 6 reports the regression results for the effect of institutional holdings on over-/under-investment. Firms with an ε <0 are in the under-investment group; firms with an ε > 0 are in the over-investment group. See Table 1 for variable definitions. Year fixed effects and industry fixed effects are included in the model. The sign of *, ** and *** denote significance at the 10%, 5% and 1% levels, respectively. Robust standard errors are in parentheses. Robust standard errors clustered at the firm level are used to address issues of heteroscedasticity and correlated error terms across firms and/or across time.

Table 7: The influence of institutional ownership on firm investment efficiency based on GMM and 3SLS estimations

	GMM	3SLS	
	(1)	(2)	(3)
	INVEFF	*INVEFF*	*INST_PR*
$INST\_PR_{i,t}$	0.174***	0.460***	
	(3.18)	(7.90)	
$INST\_PS_{i,t}$	0.002	0.004	
	(0.29)	(0.66)	
$INVEFF_{i,t}$			-0.039
			(-0.76)
$OREC_{i,t}$	0.031	-0.003	-0.053***
	(0.90)	(-0.13)	(-3.32)
$RMCOST_{i,t}$	-0.050***	-0.060***	0.007
	(-2.75)	(-7.00)	(1.14)
$FCF_{i,t}$	0.067***	0.072***	
	(2.84)	(12.39)	
$SIZE_{i,t}$	0.003***	0.001	
	(4.74)	(1.61)	
$CIRMV_{i,t}$			0.009***
			(15.93)
$TURNOVER_{i,t}$			-0.000
			(-0.20)
Constant	-0.112***	-0.095***	-0.156***
	(-7.88)	(-6.33)	(-9.91)
YEAR	control	control	control
IND	control	control	control
Hansen J	0.167		
(p-value)	(0.6827)		
Wald F	399.685		

Table 7 reports the GMM and 3SLS regression results for the effects of institutional holdings on firm investment efficiency. See Table 1 for variable definitions. *CIRMV* and *TURNOVER* are instrumental variables. The predicted value of *INST_PR* (*INST_PR^*) is used in place of *INST_PR* when *INVEFF* is the dependent variable. Year fixed effects and industry fixed effects are included in the model. The sign of *, ** and *** denote significance at the 10%, 5% and 1% levels, respectively. Robust standard errors are in parentheses. Robust standard errors clustered at the firm level are used to address issues of heteroscedasticity and correlated error terms across firms and/or across time.

Table 8: Mediation effect tests

	MEDIATOR=EFC		MEDIATOR=REV		MEDIATOR=EXEC	
	(1)	(2)	(3)	(4)	(5)	(6)
	EFC	*INVEFF*	*REV*	*INVEFF*	*EXEC*	*INVEFF*
$EFC_{i,t}$		0.008***				
		(5.13)				
$REV_{i,t}$				0.005***		
				(3.12)		
$EXEC_{i,t}$						0.004**
						(2.36)
$INST\_PR_{i,t}$	3.540***	0.021	0.329***	0.049***	1.356***	0.046***
	(20.72)	(1.49)	(2.76)	(3.09)	(13.75)	(2.92)
$INST\_PS_{i,t}$		0.003		0.002		0.004
		(0.53)		(0.36)		(0.64)
$OREC_{i,t}$	-2.909***	0.001	0.320*	-0.025	-0.107	-0.023
	(-11.52)	(0.03)	(1.88)	(-0.71)	(-1.04)	(-0.65)
$RMCOST_{i,t}$	-0.097	-0.054***	-1.917***	-0.046**	0.0420	-0.055***
	(-1.12)	(-2.74)	(-10.01)	(-2.08)	(1.10)	(-2.77)
$FCF_{i,t}$	-0.318***	0.074***	0.168***	0.070***	0.054**	0.071***
	(-4.39)	(3.03)	(4.03)	(2.89)	(2.26)	(2.93)
$SIZE_{i,t}$	0.018***	0.003***	-0.008	0.003***	-0.004	0.003***
	(2.89)	(4.55)	(-1.43)	(4.73)	(-1.49)	(4.72)
Constant	2.387***	-0.136***	0.852***	-0.121***	0.045	-0.116***
	(16.13)	(-7.86)	(6.15)	(-7.49)	(0.65)	(-7.40)
YEAR	control	control	control	control	control	control
IND	control	control	control	control	control	control
N	8372	8372	8372	8372	8372	8372
F	56.49***	25.30***	111.7***	25.43***	38.40***	24.71***
Adj_R2	0.125	0.075	0.282	0.069	0.099	0.068
Sobel test	8.591（p=0.00）		4.546（p=0.00）		3.357（p=0.00）	
Sobel-Goodman			16.40%		19.16%	

Table 8 reports the recursive regression results for the mediation effects of *EFC*, *REV* and *GGJI*, on firm investment efficiency via pressure-resistant institutional ownership. See Table 1 for variable definitions. Year fixed effects and industry fixed effects are included in the model. The sign of *, ** and *** denote significance at the 10%, 5% and 1% levels, respectively. Robust standard errors are in parentheses. Robust standard errors clustered at the firm level are used to address issues of heteroscedasticity and correlated error terms across firms and/or across time.